SCIENTIFIC AMERICAN SUPPLEMENT

Vol. III.

JANUARY–JUNE, 1877.

New-York:

MUNN & CO., PUBLISHERS.

Scientific American Office, No. 37 Park Row.

it up, or for use in hand firing, in case of a breakdown to the engine driving the feed gear or from any other cause. The screws were originally made to revolve by means of ratchet wheels and pawls, attached to a bar caused to oscillate by means of a crank and lever. Subsequently, however, the arrangements shown in the diagrams has been adopted as being more compact—that is to say, worm wheels on the axis of the screws are turned by worms on a horizontal shaft running in front of them, and driven by a belt. In the apparatus the author saw working, at Halifax, a small engine, of a single man power, is found sufficient to work two machines fitted to Cornish boilers driving 100 horse power. Any obstruction to the feed, through any extraneous substance becoming mixed with the fuel, instead of causing any breakage, merely pulls up the engine. By disconnecting the lever the feed can even be worked by hand.

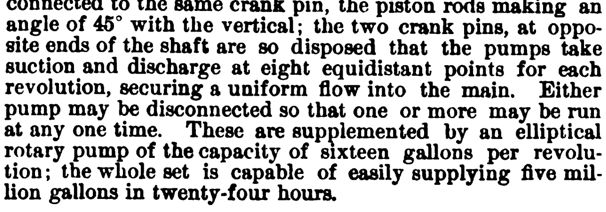
In the foregoing remarks, examples have been given of appliances for automatically supplying fuel to both internally and externally fired boilers, with both quick and slow combustion. In all of those of late date, which have been more particularly described, a great saving in coal has been effected. The author has purposely avoided any bare statements as to an economy of so much per cent., or an evaporation of so many pounds of water per pound of coal; for all such statements must be taken in connection with the nature of the fuel and the various attendant circumstances. It may be remarked, however, that the saving is twofold—first, in quality, as a cheaper or smaller coal, when properly burnt, will do the same work as larger coal subjected to imperfect combustion; and secondly, in quantity, as, for a given power, the whole, or nearly so, of the useful effect of the fuel is turned to account, instead of a large proportion going up the stack to worse than waste. Again, in addition to this saving in current expenditure, there is also that in first cost of plant, owing to smaller boilers and firegrates serving for a given power. In the event of greater power being required than was originally provided for, the more perfect utilization of fuel by an automatic stoker has been known to save the laying down of an additional boiler—no slight consideration where space is an object.

It is not, probably, contended, even by the inventors and improvers of the appliances that have been noticed, that they have as yet attained perfection; but, on the other hand, it will readily be conceded that they have made great progress, and have taken a distinct step towards extracting the whole work capable of being yielded by our "black diamonds."—*Engineer.*

WATER WORKS AT BANGOR, MAINE.

By L. H. EATON, C.E., Engineer Bangor Water Board.

THESE works are situated one and one-half miles from the post-office in Bangor, and are upon the plan of direct force, known as the Holly system. There are four piston pumps, of 12 inches diameter of cylinder and 27 inches stroke, mounted at the four corners of the base of a heavy cast-iron frame and connected to a crank shaft above. The shaft is carried in boxes on the upper arched portions of the frame, and the two pumps on each side transverse to the shaft are connected to the same crank pin, the piston rods making an angle of 45° with the vertical; the two crank pins, at opposite ends of the shaft are so disposed that the pumps take suction and discharge at eight equidistant points for each revolution, securing a uniform flow into the main. Either pump may be disconnected so that one or more may be run at any one time. These are supplemented by an elliptical rotary pump of the capacity of sixteen gallons per revolution; the whole set is capable of easily supplying five million gallons in twenty-four hours.



The pumps are driven by three American turbine wheels, made by Stout, Mills & Temple, Dayton, Ohio, eighty-four inches in diameter, working under a varying head of from five to fourteen feet, according to the rise and fall of the tide. Thus far it has only been found necessary to use two of these wheels at once, and then with a gateage of one-fourth to one-half their capacity, according to the tide, even in case of the largest fire experienced since the construction of the works. In addition, the works contain a compound steam engine, built by the Holly Manufacturing Company, the high pressure cylinder being fourteen inches diameter with a piston travel of 24 inches, and the low pressure cylinder being 21 inches diameter and 30 inches stroke. They may both be worked at high pressure when necessary.

This engine is supplied by steam by two horizontal tubular boilers of 5 feet diameter and 15 feet long, each having 54 three inch tubes, and set in a room adjoining the engine and pump room, with a smokestack outside 70 feet high. The boiler room is 39 by 40 feet, the pump and engine room is 50 feet square, and the wheel house adjoining the pump room, on the end opposite the boiler house, is 39 by 44 feet over the machinery floor, of which a tenement is finished off for the residence of the engineer.

Water is received into the wheel pit from the head race through two arches of 190 square feet area, causing the current into the wheels to be very slight, and passes from the pit into the tail race through arches of 150 feet area. The current from the wheels is very much more rapid as the tail race descends rapidly. These arches are so arranged that the water will at all times cover the entire intrados, thus excluding the cold air and preventing ice forming in the wheel house or flume. The outer or coarse rack is so arranged that it is entirely below the surface of the water in the pond, thus allowing drifting substances to pass over the dam. The fine rack is so situated that anything that passes the outer rack and the head gates draws by it and passes through the waste way of the flume into the river below; this waste way is intended also to provide for any excess of water that may pass the head gates. The gates in the wheel cases are controlled by one of Holly's automatic governors, which, by means of belts and gearing, opens them when the pressure is diminishing in the pipes, and shuts them when the pressure is increasing, a very ingenious piece of mechanism and admirable in its operation.

The pressure in the pipes is governed by a safety valve leading from the force main, which valve may be weighted to whatever pressure may be needed. For instance, the domestic pressure is 110 pounds; if five pressures is needed on high service, say 230 feet above the works (our highest service), the engineer has simply to weigh the safety valve to its proper requirement, and, setting the indicator of the governor at the required pressure, it at once runs up. If the movement be too slow to meet the need for an immediately increased supply of water, it can be expedited by the engineer turning the governor by hand.

Communication is had with the works by means of telegraphic gongs, that the engineer may be informed of any want of increased quantity of water for fire or other purposes.

The water flows from the flume to the filter through a revolving screen of copper wire netting, which catches and passes off into the wheel-pit any sawdust or other small substances that may be held in the water. The filter is of two chambers, each 12½ feet wide by 150 feet long. From these the water passes into a filtered water chamber, from which the suction pipes take it to the pumps. The filter bed is composed of brick, gravel, and sand, and yields sufficient water to supply the demand of the largest fires. The buildings are heated by steam; therefore, as our boiler is always fired up in winter, if the wheels become clogged with anchor ice, or an accident happens to them, immediate resort may be had to steam power.

The system of mains comprises 21½ miles of pipe—cast iron, tar coated—the force main is 16 inches in diameter, and extends from the works one mile into the city, at which point it is reduced to 12 inches, having, before reaching that point, been relieved by numerous secondary mains. The distance from the works to the end of the most remote pipe is about 2¾ miles. There have been set 146 hydrants, principally of the Holly pattern—a few Matthew's hydrants are in use.

The dam for the water power is at a locality known as Treat's Falls, 1¼ miles from the post-office; these falls were simply rapids with a natural descent of about 22 inches. The tide has here a mean rise and fall of about 12 feet. The crest of the dam is 8 feet above mean high tide, and has an overfall 900 feet in length between abutments; the river bottom is of slate ledge, irregular in its contours, with a trend crossing the direction of flow of the river at an angle of about 45°. The dam is of crib work filled with stone. Into the irregularities of the ledge timbers were fitted until the work was brought up to a height to admit of the regular crib work being fitted upon it, the entire structure was thoroughly bolted together with seven-eighths iron bolts, and solidly packed with rubble, common field stone, and stone from the river shores; it was then covered with 6-inch hemlock plank, the toe filled and covered to a depth of from 8 to 10 feet with gravel and stone. The accompanying sketch will give the form of the dam and an idea of its structure.

The dam was commenced at each end and extended into the river by placing tier after tier of logs from the bottom up, until the water at low tide was too deep to permit men to place the logs. The remaining gap, of some 300 feet, was then carefully sounded out at very frequent intervals, cross-sections of the lock bottom thus obtained, and cribs were built to fit the same. These cribs were as long as the breadth of the dam, some 15 or 20 feet wide, and came a little above low water level when sunk. They were successively floated to place at high tide, moored in position, adjoining the portion already partly built, and sunk by loading with stone. Jogs or shoulders on the faces in contact kept the sinking crib in line, while strong tackle drew it firmly against the end of the dam. On the receding of the tide it was filled completely with stone. The entire gap was thus filled with cribs, which came above the low water line on the lower side of the dam. A coffer dam or temporary construction was formed, to stop the flow of water over this portion and to cause it to run over the completed part. As the cribs were built hemlock posts 12" x 14", set 8 feet from center to center, and about 6 feet from the toe or upstream line of the base of the dam, were framed in vertically, in some cases being permanently fastened, and in others being fitted into deep sockets and then removed, to be put in when the dam was so far finished as to require the coffer to be planked up. This space was left to permit the passage of rafts and logs until the water could be turned through the sluice way. The posts were then put in place, the planking put on the upper side, and the coffer was thus completed. This was done under difficulties consequent upon a heavy rise in the river, but was successfully accomplished. The space thus laid bare was built up with logs, care being taken to bond the whole well together, and the stone and planking was added. After the dam was completed, the coffer planks were removed and the posts sawed off. The abutments, of granite masonry, are 10 feet 6 inches above the crest of the dam, with provision, in case of an extraordinary rise in the river, for flashboards upon the abutments and wings of two or three feet more. The expense of the dam, abutments, and wing walls has been about $150,000, and it is considered one of the most substantial dams in the country.

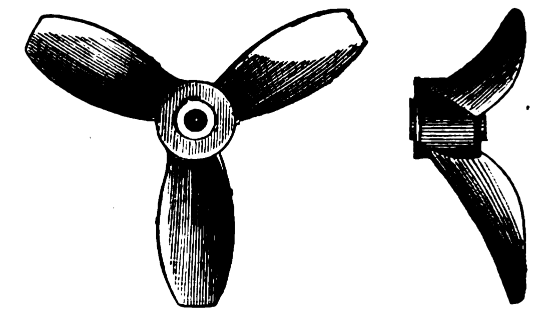
There is, at the lowest stage of the river, in the summer drought, a nominal horse power of 4,500 at mean high tide, and at low tide, of 8,700; this stage usually lasts about six weeks in the summer, and occurs in the winter for a shorter period, ordinarily about four weeks. This would give at the respective stages of the tide an effective horse power of about 3,600 and 7,000. The larger head has a duration of from one-third ebb to two-thirds flood, or for a space of about 8 hours out of the 12. Only about 45 horse power is used in driving the pumps for ordinary domestic service. The dam is so built that it can be readily increased in height when greater power is needed to supply factories and mills.

The line of the E. & N. A. Railway passes in the immediate vicinity of the dam, and will afford facilities for transportation of freight, without damage. Boats and sailing vessels of eight or ten feet draft can also come to the works to discharge and receive freight, while 20 or more feet of water is found at the railway wharves two miles below.

A fishway is being constructed upon the easterly end of the dam adjoining the abutment after plans furnished by C. G. Atkins, Esq., engineer of the U. S. Fishing Commission, at an expense of about $6,000. It has the general form of a spiral staircase, and will be ready for service in season for the spring run of fish.—*Engineering News.*

THORNYCROFT'S SCREW PROPELLER.

THE propeller designed and patented by Mr. J I. Thornycroft is shown by the subjoined engravings, from which it will be seen that the blades extend backward, at the same time curving outwards, the object being to prevent the dispersion of the water, and cause it to be thrown aft in a solid column. The screw has been applied with great success to the high-speed steam launches of which Messrs. John I. Thornycroft & Co. are well-known makers, and its application to a larger vessel is therefore a matter of some interest.



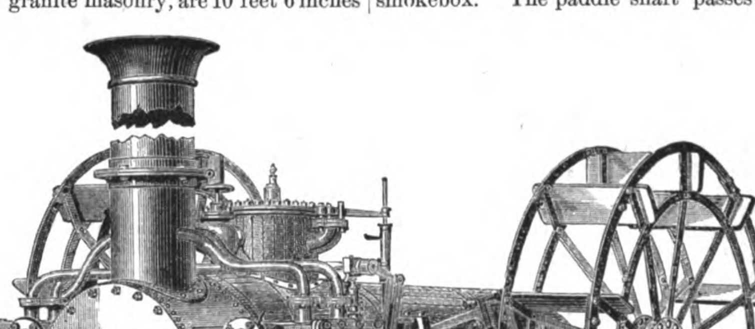
In the case of a torpedo boat, 58 ft. long, the substitution of one of Mr. Thornycroft's screws for an Admiralty screw with the corners cut off was found to increase the speed from 16¼ to 17¼ miles per hour, while in Mr. Perkins' small steam yacht, the Emily, the application of one of these screws in place of Griffith's, raised the speed about one knot in seven. Similar results have also been obtained in other instances, the speed being increased and the vibration greatly reduced. —*Engineering.*

HEATING WATER FOR STEAM-ENGINES.—The construction of the apparatus of Mr. John Coles, of London, consists of three cylinders of unequal diameter, so as to be inserted in each other, and forming a space between each for the exhaust steam and water. The innermost or smaller cylinder is to receive a portion or the whole of the exhaust steam, and passing through the same into the outer or larger cylinder, and returning back over the central cylinder, and thereby enclosing with exhaust steam internally and externally the space caused both by the smaller and central cylinders which contains the water to be heated. The space in the small cylinder and of the large cylinder which contains a constant supply of exhaust steam is very large compared with the space which contains the water to be heated, which is being pumped or injected cold in one end of the cylinder, and is passed out of the other end into the steam-boiler at a boiling point.

A PADDLE ENGINE FOR LIGHT DRAUGHT STEAMERS.

WE illustrate below a type of engine and boiler now being constructed as a specialty by Messrs. Alexander Wilson and Co., of the Vauxhall Foundry, London, and which appears to possess several considerable advantages. The boiler is of the locomotive type, and made either with a large firebox to burn wood or other vegetable fuel, or with a smaller one for coal. The cylinders are attached to horizontal frames on the side of the boiler, as shown in the engraving, or they may be inclined and bolted to the independent frame carrying the smokebox. The paddle shaft passes through a tube in the barrel of the boiler, and all the bearings are bolted to an angle-iron framing fastened to brackets riveted to the boiler and quite independent of the hull of the boat, to which they are slightly secured. The engines are fitted with the ordinary link motion reversing gear, and the boiler is provided with two auxiliary pumps. A clip pulley may be provided for hauling the boat over Rapids by means of a rope.

The sizes manufactured by Messrs. Wilson & Co. range from 25 to 100 horse power, the dimensions of cylinders from 6 in. in diameter by 15 in stroke to 12 in. in diameter by 30 in. stroke, and the diameter of paddle-wheels from 5 ft. 6 in. to 11 ft. They are adapted for boats varying from 7 ft. 6 in. beam and 50 ft. long, to 14 ft. beam and 100 ft. long. —*Engineering.*



LIGHT DRAUGHT STEAMBOAT ENGINES.